REPORT DOCUMENTATION PAGE

AFOSR-TR-95

G631

GENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
		FINAL REPORT 01 June 92 – 31 May 95

TITLE AND SUBTITLE	5. FUNDING NUMBERS
(FY91 AASERT) III-V Modulation and Switching Devices for Optical Systems Applications	XXXXXXX 3484/S3 61103D

AUTHOR(S)

Professor Singh

PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
Dept of Electrical Engineering and Computer Science University of Michigan Ann Arbor, MI 48109-2122	

SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSORING/MONITORING AGENCY REPORT NUMBER
AFOSR/NE 110 Duncan Avenue Suite B115 Bolling AFB DC 20332-0001	F49620-92-J-0304

DTIC SELECTED OCT 1 3 1995 G

SUPPLEMENTARY NOTES
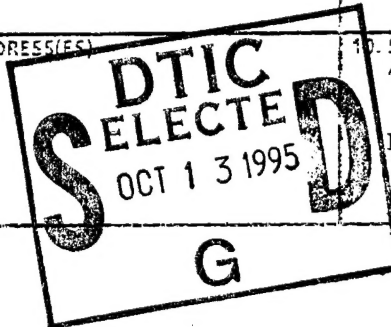
DISTRIBUTION AVAILABILITY STATEMENT

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

ABSTRACT (Maximum 200 words)

SEE FINAL REPORT ABSTRACT

19951011 019

DTIC QUALITY INSPECTED 5

SUBJECT TERMS			15. NUMBER OF PAGES
			16. PRICE CODE

SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED

The Department of Defense (DoD) requires certain information to evaluate the effectiveness of the AASERT Program. By accepting this Grant which bestows the AASERT funds, the Grantee agrees to provide 1) a brief (not to exceed one page) narrative technical report of the research training activities of the AASERT-funded student(s) and 2) the information requested below. This information should be provided to the Government's technical point of contact by each annual anniversary of the AASERT award date.

1. Grantee identification data: (R&T and Grant numbers found on Page 1 of Grant)

a.
    University of Michigan
    _____
    University Name

b. F49620-92-J-0304 – DEF   c. none
    _____   _____
    Grant Number   R&T Number

d. _____   e. June 1, 1992 – May 31, 1995
    From: J. Singh   To: Dr. C. Woods
    P.I. Name   AASERT Reporting Period

NOTE: Grant to which AASERT award is attached is referred to hereafter as "Parent Agreement".

2. Total funding of the Parent Agreement and the number of full-time equivalent graduate students (FTEGS) supported by the Parent Agreement during the 12-month period **prior to** the AASERT award date.

    a. Funding: $ 408,929
                           _____

    b. Number FTEGS: .5
                           _____

3. Total funding of the Parent Agreement and the number of FTEGS supported by the Parent Agreement during the current 12-month reporting period.

    a. Funding: $ 58,360
                           _____

    b. Number FTEGS   .25
                           _____

4. Total AASERT funding and the number of FTEGS and undergraduate students (UGS) supported by AASERT funds during the current 12-month reporting period.

    a. Funding: $ 185,832
                           _____

    b. Number FTEGS: .50
                           _____

    c. Number UGS: 0
                           _____

VERIFICATION STATEMENT: I hereby verify that all students supported by the AASERT award are U.S. Citizens.

_____   9/19/95
Principal Investigator   _____
                                          Date

Page 1 of 1 Page

University of Michigan
Grant F49620-94-1-0404, DEF

Final Report: "III-V Modulation and Switching Devices for Optical Systems Applications"

F49620-92-J-0304-DEF

6/1/92 - 5/31/95

Principal Investigator:
Professor Jasprit Singh

Co-Principal Investigator:
Professor Pallab Bhattacharya

Department of Electrical Engineering and Computer Science
The University of Michigan, Ann Arbor, MI 48109-2122

Air Force Office of Scientific Research
Bolling Air Force Base

September, 1995

The thrust of this three-year program has been to exploit quantum confined Stark effect (QCSE) in multiquantum well (MQW) structures for novel optoelectronic devices. During the course of this program a number of device concepts were implemented. We will briefly summarize the key findings of these implementations:

i) *Voltage Tunable MQW Filter Using Schottky Gratings:*
In this device an electron beam written Schottky grating is used to create a high speed modification in the optical period in a distributed feedback filter. When an electric field is applied, QCSE causes a modification of the refractive index. This concept can be exploited for creating a tunable optical filter. We were successfully able to implement this concept and several devices were fabricated. Filter tunability was demonstrated.

The device structure is grown by MBE on an n^+ GaAs substrate. A Schottky metal consisting of 250Å titanium and 1000Å gold is deposited on the AlGaAs cap layer. This metal constitutes a 128 period grating with a 0.36 micron pitch and individual finger length of 5μm. It is formed by standard electron beam lithography and liftoff techniques. A 3μm wide ridge waveguide is optically defined to pass under and perpendicular to the Schottky grating. A 0.7μm thick plasma-enhanced chemical vapor deposition (PECVD) of SiO_2 is then done to both passivate the waveguide between grating fingers and protect the surface. Contact holes to the Schottky grating strips are then opened up using RIE and a thick interconnect layer of Ti/Al/Ti/Au makes the probing pad for the Schottky contact. The waveguide is then cleaved to 400μm length for optical measurements. The diode characteristics of the device were first measured and exhibit a forward turn on voltage of 1.5V and reverse break down voltage of -16V. Photoluminescence data showed the heavy-hole excitonic peak of the wells to be at 845 nm. By the application of -2V bias on this MQW-DBR waveguide, we were able to shift the Bragg resonance by 8Å, thus demonstrating an integrable tunable filter. Through more exacting optimization, lithography calibration and longer written grating fields, devices with greater tunability, narrower bandpassing, and stronger filtering may be obtained.

ii) *Optical Header Recognition for Lightwave Networks:*
QCSE is used in this architecture to provide a real time programmable transparency for header matching to a local address. The header contains the digital code for the node where a packet is to be routed. A simple optical comparison scheme was implemented to generate a signal which is a measure of the match between the header and the local address. A high speed circuitry is used to create the programmable transparency and the final decision. We have been able to show that this scheme has an excellent potential to provide header recognition up to 10 Gbps for headers containing 8 bits.
For the 1Gb/s implementation, the 8 bit word in a NRZ format was used. To generate a programmable optical data stream at that rate, an HP80000 data generator unit was used that could produce two independently programmable signals which could significantly drive two PIN MQW GaAs/AlGaAs modulators synchronously. Continuous wave light from a commercial diode laser was focused through the first modulator which created the test data streams, as in a transmitting station. The optical data were then collected and refocused through the second modulator whose time-varying transmittance represented the stored address of a receiving station. The light is then finally collected and focused into a picosecond detector for analysis.